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"Dziadosz, Anna" <dziadosz.anna@epa.gov>
FW: Request for EPA oversight in IJC's unlawful effort to adopt nutrient water quality objectives for the Red River of the North
To: "CMS.OEX" <cms.oex@epa.gov>

Reading File

From: Daniel M Marx <DMMarx@flaherty-hood.com>
Sent: Thursday, July 2, 2020 3:30 PM
To: Wheeler, Andrew <wheeler.andrew@epa.gov>
Subject: Request for EPA oversight in IJC's unlawful effort to adopt nutrient water quality objectives for the Red River of the North

Administrator Wheeler:

Please see the enclosed electronic copy of a letter and attachments submitted today on behalf of the Minnesota cities of Breckenridge, Moorhead, Roseau, and Warroad expressing concerns and objections related to the International Joint Commission's (IJC) recommendation to adopted nutrient water quality objectives for the Red River of North, which was transmitted to the Department of State via letter from the IJC dated May 8, 2020. The IJC's proposed actions exceed the scope of its authority under the Boundary Waters Treaty of 1909, are not necessary to mitigate cross boundary impairments in the Red River and will have a major negative economic impact on rural communities in Minnesota's 7th Congressional District.

The cities are requesting that U.S. EPA coordinate with the Department of State to provide independent oversight in this matter, investigate their substantive concerns with the proposed water quality objectives and not accept the IJC recommendation to adopt them pursuant to the Boundary Waters Treaty of 1909. The cities are also requesting a meeting with the Department of State and U.S. EPA to discuss their concerns in greater detail.

Thank you for your consideration of this important matter.

Sincerely,

Daniel Marx, Senior Attorney

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July 2, 2020

VIA U.S. MAIL AND EMAIL

Director Laura Lochman
Office of Canadian Affairs
United States Department of State
Room 3918
2201 C Street,
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lochmanla@state.gov

Administrator Andrew Wheeler
Office of the Administrator
Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460,
Mail Code 1101A
Wheeler.andrew@Epa.gov

RE: Objections to the International Joint Commission's proposed nutrient water quality objectives for the Red River of the North

Dear Director Lochman and Administrator Wheeler:

We are writing on behalf of the Minnesota cities of Breckenridge, Moorhead, Roseau, and Warroad to express our concerns and objections related to the International Joint Commission's ("IJC") recommendation to the governments of U.S. and Canada, pursuant to the Boundary Water Treaty of 1909 ("the Treaty"), to adopt water quality objectives for total phosphorus and total nitrogen for the purposes of protecting the Red River of the North and, apparently, Lake Winnipeg. We are requesting your oversight of this action because it plainly exceeds the IJC's authority under the Treaty and applicable Reference and is not based on any objective information that the Red River of the North, the boundary water at issue, is suffering from cross boundary nutrient impairment. This arbitrary action, unless stopped, will adversely impact municipal and agricultural interests in our region for decades to come.

Brief Background

In September of 2019, the International Red River Board ("IRRB") formally recommended that the IJC adopt proposed total phosphorus ("TP") and total nitrogen ("TN") water quality objectives at the boundary between U.S. and Canada with the goal of restoring and protecting the Red River and Lake Winnipeg. To be clear, we do not object to making reasonable TP load reductions in the Red River for the purpose of protecting Lake Winnipeg and we are presently working on a voluntary basis with the Minnesota Pollution Control Agency ("MPCA") to do so.[1] We originally

[1] However, we continue to assert that the IJC's efforts to set water quality objectives based on the goal of protecting Lake Winnipeg, which is not a boundary water, without demonstrating cross boundary improvements in the Red River, exceeds the scope of the IJC's authority under the Boundary Waters Treaty and applicable Reference.

requested a hearing[2] on this matter before the IJC because we identified significant concerns with the proposed TP and TN concentration objectives and the TN load target. We participated in the public hearings convened by the IJC at our request and submitted comments during the public comment period which ended on March 28, 2020.

To date, we have not received any response to comments from the IJC and no direct communication from the IJC since the conclusion of the public comment period. We are concerned that the IJC decided to accept the recommendations of the IRRB and forward those recommendations on to the governments of U.S. and Canada so quickly and without responding or providing notice to those that participated in the public hearing and comment process. We did not learn that the IJC had accepted the IRRB recommendation until May 15, 2020, when we were provided a copy of the May 8, 2020 letter from the IJC to Ms. Lochman by staff at the MPCA.[3]

It is apparent that the IJC ignored the detailed technical comments submitted by our communities and others during the hearing and public comment process and failed to investigate the significant substantive concerns we and others identified.[4] This is most unfortunate because we approached the IJC in a collaborative spirit and invested significant time and resources to provide comments and technical analyses to the IJC in an effort to improve upon the IRRB's original assessment and proposal.

The proposed water quality objectives are arbitrary, capricious and exceed the IJC's legal authority under the Treaty

Our overarching concern is the IJC's proposed water quality objectives will radically alter the regulatory requirements applicable to our cities. If adopted and enforced the objectives will require us to spend millions of dollars to upgrade our wastewater treatment facilities ("WWTPs") to meet nutrient concentration and load targets that go beyond what is required by state and federal law—without a demonstration that they are necessary to protect the Red River. This concern is critical because under Minnesota's existing U.S. EPA-approved river eutrophication water quality standards, the Red River is not impaired for nutrients.[5] The IJC's proposal seeks to reverse that determination without adhering to the traditional procedural requirements or completing the type of rigorous scientific analysis that are required by Minnesota or U.S. EPA when developing new water quality standards. For example, the IJC ignored the fact that its own peer reviewers concluded that the IRRB failed to complete an analysis that demonstrates that nutrients were

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However, we continue to assert that the IJC's efforts to set nutrient load targets for Lake Winnipeg exceeds the scope of the IJC's authority under the Boundary Waters Treaty and applicable Reference.

[2] *See* Request for a public hearing on proposed numeric nutrient targets for the Red River proposed by the International Red River Board, IJC Reference 81R, from the cities of Breckenridge, Moorhead, Roseau, Thief River Falls, and Warroad, Minnesota (Oct. 16, 2019).

[3] IJC letter to Ms. Laura Lochman and Mr. Sylvain Fabi dated May 8, 2020 and attached report entitled Proposed Nutrient Concentration Objectives and Loading Targets for the Red River at the US/Canada Boundary International Red River Board – Water Quality Committee (Sep. 16, 2019).

[4] The public comments submitted to the IJC during the hearing and public comment process are hereby incorporated by reference into this letter and available here: https://ijc.org/en/nutrient2020.

[5] U.S. EPA's decision document on Minnesota's 2016 and 2018 Impaired Waters List (Jan. 28, 2019) *available at* https://www.pca.state.mn.us/sites/default/files/wq-iw1-63.pdf.

causing impairments in the Red River.[6] Consequently, and in light of the below concerns, the proposed water quality objectives are arbitrary, capricious, and exceed the IJC's legal authority under the Treaty.

Unfortunately, it is apparent that the IJC has no intent to investigate, address, or even respond to our well-founded and well-documented concerns—and those of many others. As a result, we are requesting that you work with us to investigate and address our concerns, which are detailed in the technical comments attached to this letter and summarized below:

- The IJC and IRRB exceeded their respective references, mandates, and authorities under the Treaty by proposing nutrient water quality objectives without demonstrating that nutrients are causing cross boundary impairments in the Red River and for the purpose of protecting Lake Winnipeg, which is not a boundary water covered by the Treaty.[7]

- The IJC ignored concerns by Minnesota elected officials that the proposed TN and TP water quality objectives are more restrictive than and inconsistent with Minnesota's adopted and U.S. EPA-approved water quality standards for the Red River.[8]

- The IJC ignored the opinions of multiple internationally renowned experts and overwhelming evidence that the proposal water quality objectives are not scientifically defensible[9] and that the proposed TN water quality objectives in particular would require massive unnecessary expenditures for TN reduction in the Red River Basin.[10]

Request for Assistance

As communities that face multi-million-dollar consequences as the result of the IJC's proposed water quality objectives, we cannot allow the IJC to simply ignore these issues. As a result, we respectfully request that you intervene in this matter to investigate our concerns and reject the IJC's recommendation to adopt the proposed TN and TP water quality objectives. We also request

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[6] *See* Consensus Report for the International Joint Commission on RESPEC 2016 Report (Dodds & Baulch), p.1, 8 (noting that the IRRB's consultant failed to identify thresholds at which nutrients will cause a negative biologic response in the Red River). It is also important to note that the "Consensus Report" commissioned by the IJC was not completed in a manner consistent with U.S. EPA's Peer Review Handbook.

[7] *See* Treaty Between The United States and Great Britain Relating to Boundary Waters and Questions Arising Between the United States and Canada (Jan. 11, 1909); IJC Reference 81, (Oct. 1, 1964) *available at* https://www.ijc.org/sites/default/files/Docket%2081%20Red%20River%20Pollution%20Can.%20Reference%201964-10-01.pdf; *see also* IRRB Mandate from IJC (Feb. 7, 2001) *available at* https://ijc.org/en/rrb/who/mandate.

[8] *See* Letter from Minnesota Senators and Representatives to the IJC (Feb. 28, 2020) (attached).

[9] *See* Dr. Steven Chapra, Scientific opinion on proposed numeric nutrient targets for the Red River proposed by the International Red River Board, IJC Reference 81R (Nov. 26, 2019) (attached); Letter from Drs. Scott Higgins and Michael Paterson, International Institute for Sustainable Development Experimental Lakes Area to the International Joint Commission and Red River Basin Committee, 2 (Mar. 31, 2020) (attached); Summary of Concerns with the Proposed Nutrient Concentration Objectives and Loading Targets for the Red River at the US/Canada Boundary, Hall & Associates (attached).

[10] *See e.g.,* Alice Dove and Steven Chapra, Long-term trends of nutrients and trophic response variables for the Great Lakes, Limnology and Oceanography, 696 – 721 at 717 (2015), D.W. Schindler et al., Reducing Phosphorus to Curb Lake Eutrophication is a Success, 50 Envtl. Sci. and Tech. 8923, (Aug. 6, 2016). It is also important to note that TN is not regulated under the Great Lakes Water Quality Agreement.

the opportunity to meet with you so that we can discuss our concerns with you in greater detail. It is our hope that with your assistance we be able to avoid the need for legal action to stop the IJC's arbitrary actions and can work with you and the IJC to find a collaborative resolution in this matter.

Thank you for your consideration. If you have any questions or concerns about this letter or to coordinate the requested meeting, please contact our legal representative in this matter, attorney Daniel Marx, at dmmarx@flaherty-hood.com.

Sincerely,

Jeff Pelowski, Mayor of Roseau
Renae Smith, Breckenridge City Administrator
Dan Mahli, Acting Moorhead City Manager
Bob Marvin, Mayor of Warroad

Attachments:

1. Attachment A: Dr. Steven Chapra, Scientific opinion on proposed numeric nutrient targets for the Red River proposed by the International Red River Board.
2. Attachment B: Letter from Drs. Scott Higgins and Michael Paterson, International Institute for Sustainable Development Experimental Lakes Area to the International Joint Commission and Red River Basin Committee.
3. Attachment C: Summary of Concerns with the Proposed Nutrient Concentration Objectives and Loading Targets for the Red River at the US/Canada Boundary, Hall & Associates.
4. Attachment D: Letter from Minnesota Senators and Representatives to the IJC

cc: The Honorable Senator Amy Klobuchar
The Honorable Senator Tina Smith
The Honorable Representative Collin Peterson
Director, Fabi, U.S. Transboundary Affairs Division, Global Affairs, Canada
David Ross, Assistant Administrator, EPA Office of Water
Jane Corwin, U.S. Chair, IJC
Pierre Béland, Canadian Chair, IJC
Col. Karl Jansen, U.S. Army Corps of Engineers, IRRB Board Co-Chair

Summary of Concerns with the
Proposed Nutrient Concentration Objectives and Loading Targets for the
Red River at the US/Canada Boundary

Executive Summary

Hall & Associates has been contracted by the Minnesota cities of Breckenridge, Moorhead, Roseau and Warroad ("Cities") and the Minnesota Environmental Science and Economic Review Board to summarize our technical concerns with the International Red River Board's ("IRRB's") proposed nutrient concentration objectives and load targets currently under consideration by the International Joint Commission ("IJC"). The Cities are interested in this matter because they each own and operate wastewater treatment facilities that discharge within the Red River watershed and the Minnesota Pollution Control Agency ("MPCA") has a long-history of seeking to impose mandatory effluent limit requirements on the Cities based on IJC reports and recommendations.[1]

The regulation of nutrients is extremely complex and compliance with nutrient regulations is extremely expensive for wastewater treatment facilities. Thus, before setting nutrient objectives or targets, it is critical to complete a rigorous technical analysis to ensure that such nutrient objectives and targets are both *necessary to protect* and *sufficiently protective* of the environment before setting nutrient objectives or targets. In this case, we believe that IRRB has demonstrated that the phosphorus load target for the Red River, developed to protect Lake Winnipeg, is reasonable and appropriate for the protection of Lake Winnipeg and that the IJC should accept that recommendation.

However, based on our review of the information made available by the IJC, the IRRB has failed to demonstrate that nitrogen control is necessary to protect Lake Winnipeg. IRRB's recommendation that TN reduction is necessary to protect Lake Winnipeg conflicts with the finding of several recent peer-reviewed studies demonstrating that TN reduction is not necessary to protect the Great Lakes from excessive algal growth. Based on the information presented by the IRRB and IJC, it is not apparent why such reduction is required for Lake Winnipeg and no cite-specific information has been presented showing that nitrogen control, in addition to phosphorus control, is necessary to restore acceptable algal biomass and assemblages to the lake. Therefore, unless the public is presented with clear studies, based on conditions in Lake Winnipeg, confirming that TN reduction is required to ensure algal levels decrease, this part of the proposal should be withdrawn. In addition, the IRRB has failed to demonstrate that the proposed concentration objectives for total nitrogen and phosphorus in the Red River are

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[1] *See* Memorandum, *The 1909 Boundary Waters Treaty and MPCA staff Recommendations For Total Phosphorus Effluent Limits For NPDES/SDS Dischargers in the Red River Basin" To: Lisa Thorvig et al., From: Steve Weiss and Denise Oakes* (December 4, 2012); Memorandum, *A revised Approach for Implementing Total Phosphorus Effluent Limits in the Red River Basin, Minnesota*, p.2 (MPCA, March 27, 2014)

necessary. If the proposed concentration objectives for total nitrogen and phosphorus and the load target for total nitrogen are adopted and implemented, it will lead to unnecessarily costly regulatory requirements for the cities—especially with respect to total nitrogen.

Based on our review of the technical information made publicly available by the IJC we opine and recommend the following:

(1) The proposed total phosphorus load target for the Red River, developed to prevent and mitigate excessive algal biomass and harmful algal blooms in Lake Winnipeg, is reasonable and scientifically defensible. Further, it is our opinion that the total phosphorus load target is the only proposal under consideration by the IJC that is actually *necessary* to protect Lake Winnipeg. We recommend that the IJC accept this recommendation.

(2) The proposed concentration objective and load target for TN are not scientifically defensible, are inconsistent with and more restrictive than Minnesota's adopted and USEPA approved River Eutrophication Standards applicable to the Red River and are not necessary to protect Lake Winnipeg. Further, the proposed total nitrogen recommendations are inconsistent with recent peer-reviewed literature evaluating the Great Lakes. We recommend that the IJC withdraw these recommendations unless and until the critical scientific deficiencies identified by Hall & Associates and Dr. Steven Chapra are substantively addressed.

(3) The proposed total phosphorus concentration objective for the Red River is not scientifically defensible, is inconsistent with and more restrictive than Minnesota's adopted and USEPA approved River Eutrophication Standards and is not necessary to protect Lake Winnipeg. We recommend that the IJC withdraw this recommendation unless and until the critical scientific deficiencies identified by Hall & Associates and Dr. Steven Chapra are substantively addressed.

Background

The technical basis for the proposed nutrient concentration objectives at issue is a report entitled, The Development of a Stressor-Response Model for the Red River of the North, RESPEC, June 2016 (RESPEC Report).[2] The Cities were never formally notified about the completion of this report. However, via their independent inquiry, they became aware of the RESPEC Report and proposed concentration objectives in 2018. In July of 2018 the Cities submitted technical comments prepared by Hall & Associates evaluating the technical basis for the proposed concentration objectives to the IRRB.[3] The comments noted numerous deficiencies demonstrating that the proposed nutrient concentration targets were not scientifically defensible

[2] The Development of a Stressor-Response Model for the Red River of the North. TopicalReport.RSI-2611, RESPEC, June 2016.

[3] Review of: The Development of a Stressor-Response Model for the Red River of the North, RESPEC, by Hall & Associates, June 4, 2018 ("Hall & Associates Review of RESPEC Report").

and requested that they be peer reviewed via public process consistent with Minnesota Law or withdrawn by the IRRB.

In response to the comments contained in the Hall & Associates review of the RESPEC Report, the IJC requested that Dr. Walter Dodds and Dr. Helen Baulch conduct a peer review of the RESPEC Report with specific attention to the concerns raised by Hall & Associates. These authors reviewed the documents and prepared an evaluation titled "Consensus report for the International Joint Commission on RESPEC 2016 Report", March 8, 2019, ("Consensus Report"). The Cities were not given an opportunity to provide feedback on the charge questions or the selection of the peer reviewers. This peer review resulted in the Consensus Report, which fully supported the proposed nutrient endpoints after acknowledging numerous problems with the original report. [4]

The Cities received a copy of the Consensus Report on September 26, 2019 although it had been completed in March, 2019. However, it is our understanding the IRRB met in Gimli, Manitoba, on September 10-11, 2019, with no notice to the Cities and elected to forward the proposed nutrient targets to the IJC for consideration—before the Cities were given an opportunity to review and respond to the Consensus Report. The Cities submitted a request for a hearing to the IJC related to the proposed nutrient concentration objectives on October 16, 2019.

The Cities then asked Dr. Stephen Chapra, a nationally recognized expert in stressor-response modeling and a distinguished researcher who has assisted the IJC over the past 40 years, to review the RESPEC report and the analysis provided by Hall & Associates to provide his expert opinion about the scientific defensibility of the proposed concentration objectives. Dr. Chapra concluded that the proposed nutrient concentration targets for the Red River were not based on sound science.[5]

The Cities subsequently became aware of proposed nutrient concentration targets for Lake Winnipeg and corresponding nutrient loading targets for the Red River in January 2020, when the IJC granted and issued a public notice for the hearing requested by the Cities. The public notice included a report entitled Proposed Nutrient Concentration Objectives and Loading Targets for the Red River at the US/Canada Boundary, IRRB, September 2019 (IRRB Report). The IRRB Report was a summary proposal and did not contain specific information regarding how the Lake Winnipeg nutrient concentration objectives and loading targets were developed. We have been able to glean the basis for the proposed TP load reductions, based on the TP concentration objectives for Lake Winnipeg, from hyperlinks contained within the September 2019 report (revised November 25, 2019).

However, as noted above, additional information is necessary to understand the basis for the TN concentration objective and load targets. The existing information made available by the IJC does not indicate that TN reduction is required to ensure significant algal growth reduction in

[4] Consensus report for the International Joint Commission on RESPEC 2016 (Dodds & Baulch, March 2019).
[5] Letter from Dr. Chapra, Scientific opinion on proposed numeric nutrient targets for the Red River proposed by the International Red River Board, IJC Reference 81R (Dec. 6, 2019) ("Chapra Analysis").

Lake Winnipeg. The relevant studies all state that excessive TP loading is causing the problem and TN regulation is presented as an afterthought or speculation that such reduction might be needed (e.g., as a nutrient ratio based on the TP criteria identified).

The comments presented below summarize our significant concerns with the Red River nutrient concentration objectives, as previously submitted, and includes a more detailed response to the assessment presented in the Consensus Report. We are also providing comments on the IRRB Report, based on the various information presented in the report and the attached supporting information, outlining our concerns regarding the proposed TN load objectives proposed for Lake Winnipeg.

Comments on the Proposed Nutrient Concentration Objectives and Loading Targets for the Red River at the US/Canada Boundary

1. Summary of Scientific Concerns with Red River Objectives

Nutrient concentration objectives for the Red River of the North were originally developed in the June 2016 report by RESPEC (The Development of a Stressor-Response Model for the Red River of the North). This report was the subject of comments by Hall & Associates (July 11, 2018) and a peer-review style report by Dodds and Baulch (March 8, 2019) Finally, Dr. Steven Chapra reviewed all these documents and provided his own independent assessment. (December 6, 2019). Hall & Associates provided additional comments to the IJC, via a PowerPoint Presentation, during the Public Comment meeting on January 16, 2020.

a. Comments on RESPEC Report

Overall, the nutrient concentration objectives contained in the RESPEC Report should be withdrawn as not necessary to protect aquatic life uses in the Red River because the proposed TP and TN criteria are not based on accepted impairment thresholds. The primary technical deficiencies identified by Hall & Associates (July 11, 2018) were:

- The recommended nutrient targets were based on data that do not reflect the conditions in the river using metrics that are not related to designated use attainment. The periphyton data were obtained from glass slides floating near the surface of the river to maximize algal growth because the river is too turbid to allow such growth to occur naturally. These data were then evaluated using algal community metrics (i.e., saprobity, nutrient tolerance, nitrogen uptake metabolism) with no demonstrated relationship to aquatic life use attainment.
- Establishment of a TN target is inconsistent with Minnesota's River Eutrophication Standards and the proposed TN concentration target was developed using metrics that are not related to designated use attainment. The MPCA specifically adopted the RES noting that TN criteria were not necessary to protect designated uses. The specific metric used to characterize desirable periphyton communities, nitrogen uptake metabolism, is not associated with any assessment of use impairment and the RESPEC Report provides no information showing why such communities are "desirable" or what metric value constitutes a threshold for aquatic life use attainment based on "desirable communities".
- The primary assessment metric, periphyton growth, was based on surface mounted samplers that do not reflect the actual growth that occurs in the river. The results of this testing are artificial and cannot be used to predict periphyton growth in the river or the response to changes in nutrient concentration.
- The Report claimed to follow USEPA's stressor-response guidance for developing the proposed nutrient targets. In reality, a stressor-response relationship was not developed, and no impairment thresholds were identified. As a consequence, there is no confidence that the recommended nutrient concentrations will cause a shift to more desirable communities (assuming that is necessary to ensure attainment of aquatic life use).

- Adjacent land use characteristics may be responsible for the observed taxonomic effects. Such a relationship was identified in the RESPEC Report and it was shown to explain more of the variability in response than changes in nutrient concentration. Consequently, nutrient control may have no effect on shifting to more desirable communities.[6]

The proposed objectives merely represent the average concentration observed at three locations *assumed* to possess the most desirable algal communities.[7] However, the RESPEC Report was tasked with developing a stressor-response relationship along a nutrient concentration gradient, but, as noted by Hall & Associates, Dr, Chapra and confirmed by the Consensus Report, no such relationship was developed.[8] Consequently, it is apparent that the proposed TP and TN targets are not demonstrated to be necessary to protect the aquatic life uses of the Red River of the North. They certainly are not required to ensure excessive plant growth does not occur, as it is not occurring under existing ambient conditions.

Contrary to most nutrient criteria adopted by other states, the RESPEC Report did not identify a periphyton or phytoplankton chlorophyll-a endpoint for excessive algal growth.[9] However, all phytoplankton chlorophyll-a concentrations were less than the criterion established by the MPCA for the Red River, and the periphyton data used as the basis for selecting the proposed nutrient targets are associated with chlorophyll-a concentrations nearly an order of magnitude less than that used in states with such criteria. Moreover, the periphyton data were derived for artificial growing conditions that maximize growth. These data, considered collectively, show that the Red River is not suffering adverse effects from nutrients and does not need an independent set of nutrient objectives.[10]

Finally, the recommendation that nitrogen objectives are necessary to protect the Red River is contrary to the historical approach used by the IJC and has not been justified by any scientific analysis showing that such control, in addition to phosphorus control, is necessary.[11]

b. Comments on Consensus Report

The Consensus Report assessed five points: (1) review of the primary issues of concern raised in the Hall & Associates Report, (2) was the stressor-response model developed for the Red River appropriate to address the charge from the Statement of Work (SOW), (3) was the stressor-response model appropriately applied to address the charge from the SOW, (4) was the field study design and data collected appropriate to fill data gaps and address the SOW, and (5) were the statistical methods used applied correctly to address the SOW.[12]

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[6] *See Supra,* ("Hall & Associates Review of RESPEC Report").
[7] *See*, RESPEC Report at 63 (stating "the TP and TN averages for the three sites having the lowest biomass and most desirable communities was 0.15 mg/L and 1.15 mg/L, respectively").
[8] *See* Consensus Report at 8.
[9] *See* Chapra Analysis at 3-4.
[10] *Id.*
[11] TN is not regulated under the Great Lakes Water Quality Agreement. *See generally* Great Lakes Water Quality Agreement, *available at* https://binational.net//wp-content/uploads/2014/05/1094_Canada-USA-GLWQA-_e.pdf.
[12] *See* Consensus Report at 1, 8.

- Initial Concerns

In the October 16, 2019 letter from the Minnesota Cities to the IJC requesting a public hearing on the proposed numeric nutrient targets, several concerns were raised regarding the Consensus Report. These concerns included:

- The objective of the RESPEC Report was to identify biological use impairment thresholds and develop a stressor-response model to determine nutrient criteria necessary to protect those uses. The Consensus Report acknowledged that biological thresholds were not identified and then supported the proposed TP and TN targets because they reflect water quality from "higher quality" areas. This is not a defensible position;
- The Consensus Report supported the derivation of numeric targets for TN, claiming this position is supported in the literature. The assertion that TN control is necessary to protect designated uses is contrary to MPCA's River Eutrophication Standards and the long-standing approach used by the IJC in the Great Lakes which do not require TN control. The specific issue is whether TN reduction is necessary to ensure ecological protection and neither the RESPEC Report nor the Consensus Report made such a demonstration;
- The Consensus Report supported the use of floating periphytometers to characterize periphyton characteristics in the Red River while acknowledging known masking effects of turbidity and TSS on algal responses to nutrients. There was no attempt to demonstrate that the periphytometer results bear any relationship to existing or future potential conditions in the river. If anything, these results show that periphyton growth, as measured by chlorophyll-a concentration, does not cause use impairment even under the most favorable growing conditions.[13]

- Consensus Report Focus on Reference Conditions Inappropriate

The primary concern raised by Hall & Associates was that a threshold for impairment was not identified. Consequently, a stressor-response model relating the impairment metric to increasing nutrient concentration could not be used to identify the nutrient target because no response target was identified. In responding to this comment, the Consensus Report stated:

> Concern was noted by Hall & Associates regarding the use of measures such as saprobity metrics, nutrient tolerance, and nitrogen uptake metabolism group. These metrics are provided in the report, but the establishment of the criteria on page [sic] does not appear to rely on these metrics, instead, it relies on the partial redundancy analysis of taxonomic data averaging the three sites where the strongest and weakest relationships were found -- and using nutrient concentrations at these sites to estimate the nutrient concentrations associated with more desirable communities.[14]

[13] *See* Chapra Analysis at 5, 8.
[14] Consensus Report at 2.

The Statement of Work for the RESPEC Report intended to use a stressor-response relationship and a biological threshold along a stressor (nutrient) gradient to identify the nutrient target necessary to protect the Red River. As noted in the Consensus Report, the RESPEC Report "did not identify specific biological "thresholds" (point 6), rather they found conditions in least impacted areas and used those to recommend criteria."[15] However, as described in the SOW, the intent was to identify a response variable that represents a threshold above which the river is impaired and relate that response variable to a nutrient gradient. The nutrient concentration at which the response variable exceeds the threshold becomes the nutrient target.

The Consensus Report authors seem to be distinguishing between the specific metrics (saprobity, nutrient tolerance, nitrogen uptake metabolism) and "more desirable communities", as though this distinction makes a difference. It does not. If "more desirable communities" is used as the basis for setting the nutrient target, this term must be defined and a value representing a threshold for impairment must be identified if a stressor-response evaluation is used to develop the nutrient target. This was not done. Moreover, it is apparent that the Consensus Report has misinterpreted the intention of the IJC (i.e., use a stressor-response analysis to develop numeric nutrient concentration objectives).

The evaluations presented in the Consensus Report repeatedly refer to "minimally impacted sites" and "reference sites" as the basis for establishing the nutrient targets. The Consensus Report concludes with a list of reference concentrations (See, Table 1) and comments that these reference concentration nutrient targets represent the range for protection of rivers in the region. This reference-site approach does not account for confounding factors and is unrelated to the adverse responses associated with eutrophication (therefore it fails to show that the proposed regulation is necessary).

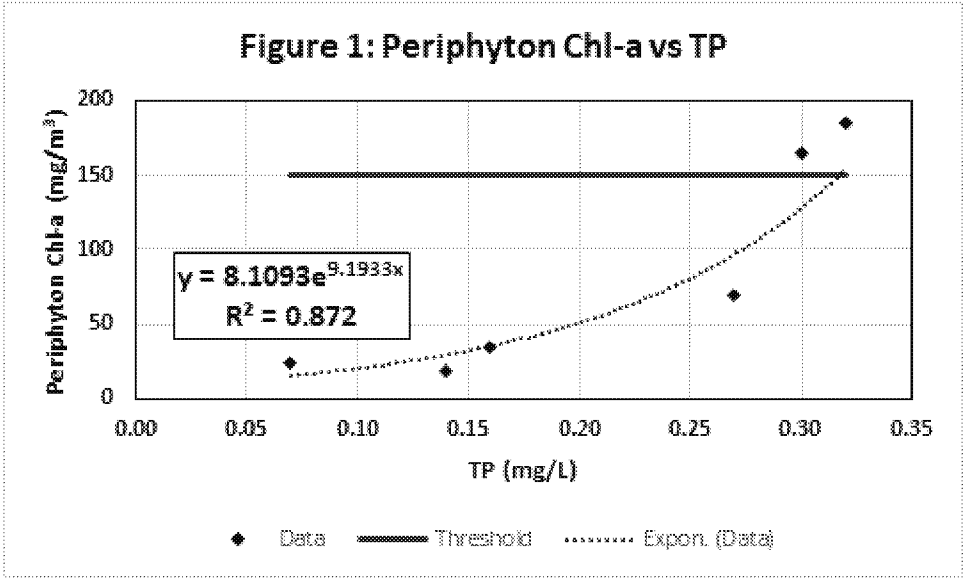
This error is illustrated in the Consensus Report recommendations regarding the use of simple correlations to justify the RESPEC nutrient targets.

> Given the potential statistical problems (or subjectivity) in the original report with determination of reference sites, we took an alternative approach to visually assess the validity of the results of the report. Using data presented on page E1 we explored simple relationships within the TP, TN, and periphyton chlorophyll data. …
>
> We note that interpretation of this plot is sensitive to the TSS threshold applied, with a lower threshold leading to greater linearity. Nonetheless, we conclude the proposed TP criteria (from page 64 of RESPEC) of 0.15 mg TP/L is representative of more desirable conditions based on the lower periphyton chlorophyll a.[16]

The authors of the Consensus Report took data from the surface periphytometers and plotted the data as a simple linear regression. The authors claim that this simple regression supports the proposed TP target because lower periphyton chlorophyll-a is a more desirable condition. This is clearly an erroneous conclusion. The authors equated lower periphyton chlorophyll-a with more

[15] *Id* at 8.
[16] *Id* at 3.

desirable conditions and assumed this represented a threshold of impairment. The more desirable periphyton chlorophyll-a concentration was less than 40 mg/m^2.[17] This is an exceedingly low level of periphyton biomass and is not recognized as a threshold of impairment elsewhere. For example, the State of Montana (Suplee et al. 2009) uses mean periphyton chlorophyll-a levels < 150 mg/m^2 as meeting designated uses. Earlier work in the literature suggests that chlorophyll-a concentrations of 100-150/m^2 represents a benthic algae nuisance threshold (Horner et al. 1983, Welch et al. 1988, etc.). The Minnesota Pollution Control Agency (MPCA) uses a growing season average periphyton chlorophyll-a concentration of 150 mg/m^2.[18] If an impairment threshold was used as the basis for assessing the nutrient target, a significantly higher TP concentration would be identified, assuming that TP concentration caused the observed periphyton chlorophyll-a concentration. (Figure 1). Information presented in the RESPEC Report, and discussed below, suggest that factors other than TP are controlling the observed algal growth.



- Periphyton Data Not Representative of Actual Growth in the Red River

The biological threshold necessary for this analysis is the periphyton chlorophyll-a concentration expected to occur in the Red River, not the concentration that can grow on a glass slide under ideal growing conditions. A review of the published methodologies used by multiple states shows that the use of surface periphytometers is not a method recommended for characterizing algal growth in streams.[19] Virtually all of the methods reviewed discuss the use of natural substrates as the basis for characterizing periphyton growth.

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[17] *Id* at 3-5.

[18] Minn. R. 7020.0222, subp.2b. (C).

[19] For example, the procedures recommended by the USGS for periphyton sampling provides "Regardless of which sample types are collected in a particular study, all samples are collected from instream habitats that are present in the reach." USGS. 2002. Open File Report 02-150. Revised Protocols for Sampling Algal, Invertebrate, and Fish Communities as Part of the National Water-Quality Assessment Program at 15. (emphasis added)

In response to comments that the results from the floating periphytometers over-estimated the actual growth of periphyton in the river and cannot be used to assess impairment status, the authors of the Consensus Report provided several conflicting comments without agreeing or disagreeing with the concern. These include the following:

- "numerous shallow solid surfaces occur in the river upon which algae can grow";
- conditions on the slides "may be somewhat different than average conditions in the river";
- "[a]lgae that are in the river colonize the periphytometers, and they are subject to the same forms and concentrations of nutrient that occur throughout the river";
- [periphytometers] are an "excellent measure of the potential for algal growth in the river";
- smooth substrata (i.e., slides) in general "attain lower amounts of chlorophyll than rougher substrata as sloughing is greater and a complex surface gives more area to colonize"; and,
- "many may be more shaded than the periphytometers except in shallow portions."[20]

In contrast to the lack of a definitive statement in the Consensus Report, the RESPEC Report clearly noted "Surface-mounted samplers were expected to provide the greatest opportunity for periphyton growth (i.e., least light limitation), which was important given the general doubt of algal abundance in the river.[21]

- USEPA Stressor-Response Guidance Ignored

In response to the concern raised that the RESPEC Report did not follow USEPA's guidance on conducting stressor-response, The Consensus Report makes several claims.

- "The stressor-response approach is not extremely prescriptive by the EPA, and the approach was followed in general."
- The work did use several response variables that would be reasonable. These include phytoplankton and periphyton biomass and community structure."
- "The low r^2 associated with model fits (0.15 and 0.16) is a concern. However, a simple plotting of the data in appendix E -- (Figure 1 & 2 here) shows the proposed TP and TN criteria from the RESPEC report is a reasonable one."[22]

We note that USEPA's Stressor-Response Guidance is based on a presumption that the stressor-response evaluation is based on a response metric that is directly linked to designated uses and there is a threshold, above which, uses are impaired. [23] As noted earlier, the metric used to develop the proposed nutrient concentration objectives, "more desirable communities", is

[20] Consensus Report at 6-7.
[21] RESPEC Report at 23.
[22] Consensus Report at 7.
[23] Using Stressor-response Relationships to Derive Numeric Nutrient Criteria. USEPA. November 2010. "Variables are selected during this step that represent different concepts shown on the conceptual model, including variables that represent N and P concentrations, variables that represent responses that can be directly linked with designated uses, and variables that can potentially confound estimates of stressor-response relationships, at ix.

undefined, no threshold level was identified, and no stressor-response relationship was developed. The suggestion that simple data plotting, as illustrated above in Figure 1, shows the proposed nutrient criteria are reasonable is overly simplistic and seriously flawed as previously discussed.

- Effects of Adjacent Land Use Characteristics Ignored

In response to a concern that adjacent land use characteristics exert a significant influence on the periphyton metrics and explain the greatest amount of variance in the data, the Consensus Report commented that the authors did not see strong evidence for adjacent land use characteristics driving algal biomass at specific sites.[24] This comment is directly at odds with the findings in the RESPEC Report:

> To increase our understanding of all stressors in the Red River, an additional assessment to discern the effect of land use on the algal community was performed. Constrained ordinations with measures of land-use attributes from the SPARROW model and from subsequent GIS manipulations of the summarized data (Figure 7-13 and Figure 7-18) were included in an attempt to quantify the persistent influence of stressors based on general knowledge of the effect of anthropogenic disturbance drivers in subwatersheds on aquatic communities. Efforts were made to view these stressors in light of potential nutrient sources. Although phytoplankton's explained variance with the land-use ordination was higher than the chemistry analysis (23 percent versus 16 percent), the explained variance in the periphyton communities was appreciatively higher (35 percent versus 15 percent) and both analyses revealed ecologically meaningful correlations. Shown in Figure 7-13 (phytoplankton/land-use RDA diagram), the strong association of the percentage of riparian wetlands with the *x*-axis indicates that the variance in the phytoplankton data between sites was very strongly correlated with this land-use parameter.[25]

The implications of the strong correlation reported in the RESPEC Report goes to the proper application of stressor-response evaluations to developing scientifically defensible numeric criteria for nutrients. USEPA's guidance on the use of stressor-response relationships discusses the need to properly define and account for confounding factors when using this technique.[26] However, because the authors of the Consensus Report characterized the Guidance as "not extremely prescriptive", they dismissed the significance of this requirement. However, without properly accounting for confounding factors that are strongly correlated with the algal metrics, there is limited confidence that controlling for nutrients will achieve the goal of restoring more desirable communities.[27]

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[24] Consensus Report at 7.

[25] RESPEC Report at 61 (emphasis added).

[26] See, USEPA. November 2010, Chapter 5 – Evaluate and Document Analysis.

[27] *See*, SAB Review of Empirical Approaches for Nutrient Criteria Derivation. EPA-SAB-10-006. "[M]ore careful consideration of confounding variables is necessary to maximize the potential for stressor-response relationships to reflect cause and effect between nutrient concentrations and ecological responses." (at xix)

c. Comments Provided by Steven Chapra

The Minnesota Red River cities obtained an opinion from Dr. Steven Chapra on the efficacy of the RESPEC Report, the review prepared by Hall & Associates, and the Consensus Report. Dr. Chapra is an internationally respected researcher who has provided approximately 40 years of consulting services to the International Joint Commission. His December 6, 2019 letter identified the same deficiencies reported by Hall & Associates and concluded that the TP and TN concentration objectives identified for the Red River were not scientifically defensible. He provided the following general observations regarding these reports:

- "No evaluation is presented to identify a threshold for aquatic life use impairment associated with any plant growth metric. . .This is not a scientifically defensible method for deriving numeric nutrient criteria to protect aquatic life uses."[28]
- "The proposed endpoints are not justified because they are not grounded in any demonstrable significant adverse impact from eutrophication or, for that matter, even the existence of a eutrophic condition."[29]
- "These data [periphyton and phytoplankton chlorophyll-a concentrations] suggest that nuisance algal growth is not occurring in this river, even under artificially ideal growing conditions."[30]
- "The RESPEC Report does not contain any demonstration [showing TN control alone is necessary to reduced algal growth] and, therefore cannot serve as a scientifically defensible basis for the recommended TN endpoint."[31]
- "While the use of floating periphytometers may be useful in identifying the forms of periphytic algae that are present in the river and possible maximum growth levels when growing conditions are optimized, these data are not representative of the relative biomass of these species occurring under existing conditions or reasonably expected to occur in the future."[32]

Dr. Chapra also noted that the simplified regression analysis presented in the Consensus Report shows periphyton chlorophyll-a levels are greatly reduced at TP concentrations below 0.15 mg/L and greatly increased at TP concentrations above 0.27 mg/L.[33] Numerous scientific studies have shown that periphyton growth should be unlimited at TP concentrations greater than 0.05 mg/L.[34] The fact that chlorophyll-a levels were very low at TP concentrations up to 0.15 mg/L confirms that other factors are controlling the growth of periphyton on the surface-mounted slides, as observed in the RESPEC Report.

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[28] Chapra Analysis at 3.
[29] *Id* at 4.
[30] *Id.*
[31] *Id* at 5.
[32] *Id* at 6.
[33] Chapra Analysis at 8.
[34] Dodds, one of the authors of the Consensus Report, reported that periphyton can achieve impressive biomass in nutrient poor waters. Dodds. 2006. Limnol. Oceanogr., 51(1, part 2), 2006, 671–680 (at 677).

> The location of the periphytometers at the water surface should have ensured adequate surface light, although the possibility of limited light appeared to remain because no other explanations were apparent to describe the limited algal growth in the presence of abundant nutrients.[35]

This factor was not identified. Without identifying and accounting for these confounding factors, the proposed nutrient targets are unreliable. (See, EPA-SAB-10-006 at 24 - The statistical methods in the Guidance require careful consideration of confounding variables before being used as predictive tools.)

2. Review of International Red River Board – Water Quality Committee Report: Proposed Nutrient Concentration Objectives and Loading Targets for the Red River at the US/Canada Boundary (revised November 25, 2019)

The Proposed Nutrient Concentration Objectives and Loading Targets for the Red River at the US/Canada Boundary (IRRB, September 16, 2019; revised November 25, 2019) included loading targets to protect Lake Winnipeg in addition to the concentration targets specified in the RESPEC Report for the Red River. The Minnesota Red River Cities were not aware of these Lake Winnipeg targets prior to the release of the IRRB proposal. Based on the information presented in the IRRB proposal (at 3), two independent approaches were used to develop the recommendations contained in the report:

- A stressor-response modeling approach to develop recommendations for nutrient concentration objectives for the Red River.
- A "downstream" approach based on the nutrient targets for Lake Winnipeg to develop recommendations for nutrient loading targets.

As discussed in Part 1 of these comments, the TP and TN concentration objectives (developed using stressor-response modeling) have not been shown to be necessary to protect the Red River. Moreover, the concentration targets are inconsistent with the water quality objectives established by the MPCA for limiting algal growth. The downstream TP load approach to protect Lake Winnipeg is appropriate, but some aspects of the recommended approach should be reconsidered, particularly the requirement to control TN.

a. Review of Proposed Nutrient Concentration Objectives and Loading Targets for the Red River.

Our primary concerns with the nutrient concentration objectives have been presented above. Additional concerns are presented below.

[35] RESPEC Report at 50.

- Conclusions Contrary to Minnesota Pollution Control Authority Determinations

  - Water Quality Standards Development

    When the MPCA developed the River Eutrophication Standards (RES), it specifically determined that nitrogen control was not necessary.[36]

  - Determination on Impairment Status for the Red River

    The MPCA has repeatedly determined that, although the Red River exceeded the TP criteria for southern rivers, it is not impaired because the response metrics necessary to confirm impairment (phytoplankton chlorophyll-a concentration, dissolved oxygen swing, BOD_5 concentration) are not exceeded.[37] The proposed nutrient concentration objectives are based on the assumption that the river is impaired for aquatic life uses.

  - Proposed standards more restrictive than existing Minnesota criteria

    The RES are expressed as long term, growing season (June – September) average concentrations for TP, phytoplankton chlorophyll-a, dissolved oxygen swing, and BOD_5 concentration.[38] In developing the stressor-response evaluation presented in the RESPEC Report, only single-point-in-time measurements were made to characterize TP and phytoplankton characteristics. These measurements were taken under conditions expected to maximize the observed conditions and the proposed objectives are specified as seasonal averages for each year.

- Comments on Concentration Objectives versus Loading Targets for the Red River

The Proposed Nutrient Concentration Objectives and Loading Targets for the Red River at the US/Canada Boundary (IRRB, September 16, 2019; revised November 25, 2019) included a TP load target based on TP concentration objectives designed to protect Lake Winnipeg as identified by the paleolimnology studies referenced below. This TP concentration objective for Lake Winnipeg was converted to an annual load and separate allocations were provided for the Red River at the US/Canada border and the other sources entering the Lake. Information presented in the IRRB proposal demonstrates that the TP concentration targets for the Red River based on RESPEC's stressor-response modeling are significantly more restrictive than the TP loading targets proposed to protect the lake. (See IRRB Report, Figure 3 at 10, reproduced below, showing that the hypothetical nutrient loads based on meeting the proposed concentration objectives are significantly lower than the proposed loading target to protect Lake Winnipeg). Thus, the proposed TP concentration objective for the Red River is not necessary to protect Lake Winnipeg (i.e. achieve the proposed TP loading target that was specifically developed to protect Lake Winnipeg).

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[36] Statement of Need and Reasonableness, Eutrophication Standards for Streams, Rivers, Lake Pepin, and Navigational Pools, Book 2, Minnesota Pollution Control Agency, 103, *available at* https://www.pca.state.mn.us/sites/default/files/sonar-book2.pdf.

[37] Minnesota Impaired Waters List, Minnesota Pollution Control Agency, (2020), *available at* https://www.pca.state.mn.us/water/minnesotas-impaired-waters-list.

[38] *See* Minn. R. 7050.0222.

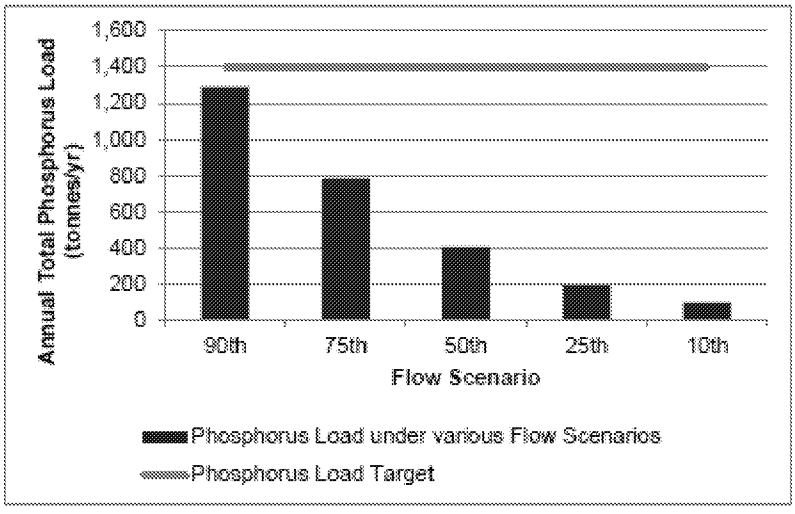

Figure 3. Hypothetical nutrient loads based on meeting the proposed concentration objectives under five flow scenarios at the US/Canada border. Green bar represents loading target necessary to protect Lake Winnipeg.

Moreover, the proposed nutrient loading targets are five-year running average loads while the proposed concentration objectives are expressed as seasonal averages for each year.[39] Taking variability into account, compliance with the proposed concentration objectives on an annual basis will require the five-year running average concentration to be approximately half the proposed load target. Thus, the proposed concentration objective for TP is far in excess of the proposed loading target and is not necessary to protect Lake Winnipeg.

Summary

As discussed above, nutrient concentration objectives for the Red River are not linked to a use impairment threshold in a scientifically defensible manner, they are contrary to the MPCA's determination that the Red River is not impaired by nutrients, and will result in limitations that are much more restrictive than that determined necessary to protect Lake Winnipeg. Therefore, these nutrient concentration objectives should be removed from the IRRB's proposal to protect these waters.

b. Concerns with TN Concentration Objectives and Load Targets for Lake Winnipeg

The IRRB Report indicated that the loading targets for Lake Winnipeg were derived from paleolimnology studies evaluating phytoplankton communities and TP levels observed in the Lake. Based on these studies, it was recommended "that total phosphorus concentrations [in Lake Winnipeg] be reduced back to 1990s levels of 0.05 mg/L to reduce the frequency and severity of cyanobacteria blooms."[40] This approach seems reasonable. However, the report then recommended TN objectives without a determination that TN control was necessary to achieve

[39] *See* IRRB Report at 11-12 – Application.
[40] IRRB Report at 7.

the stated objective. This TN objective is not based on any demonstration of need and is contrary to the long-standing and successful approach for addressing nutrient issues in the Great Lakes.[41]

- Minnesota Does Not Regulate TN

The State of Minnesota's adopted and USEPA approved Lake Eutrophication Standards (LES) establish TP criteria and response criteria for Minnesota lakes.[42] The LES do not establish nitrogen criteria for lakes because the MPCA has independently determined that TN is not a routine stressor that controls algal growth in Minnesota lakes.[43]

- The IJC Does Not Regulate TN in the Great Lakes

Eutrophication control in the Great Lakes has focused on the control of phosphorus loads to these lakes. This program has been very successful in reducing phytoplankton chlorophyll-a concentrations and is proof that TN control is not necessary as an independent requirement in these systems. See, for example, the assessment of long-term trends of nutrients and trophic response variables in the Great Lakes.[44] This study presented data showing that TP control was sufficient to control algal growth, even as TN (primarily as nitrate) concentrations increased.

> It has become clear in hindsight that the management of nitrogen at that time would have been largely futile and wastefully expensive, as the system was clearly phosphorus limited and has become increasingly so as P loadings were reduced (Schelske 2009).
>
> This result has implications beyond the Great Lakes. In recent years, there has been a push to control eutrophication of freshwater systems by simultaneously regulating both phosphorus and nitrogen (e.g., Lewis and Wurtsbaugh 2008; Lewis et al. 2011). As eloquently argued by several experts (e.g., Schindler et al. 2008; Schelske 2009; Schindler and Hecky 2009; Schindler 2012) and supported by our study of the Great Lakes, universally adopting such a strategy for all freshwater systems would be an ineffective and costly strategy for mitigating eutrophication.
>
> (Dove and Chapra 2015 at 717)

- Independent Review by Dr. Chapra States TN Control Not Routinely Necessary

The independent review provided by Dr. Chapra commented on this issue and concluded that "there is no consensus that TN control is necessary in fresh waters, and, if anything, the consensus is that it is not generally a good idea (Schindler et al. 2015). Moreover, while TP control has been shown to effectively limit algal growth in freshwater systems, I am not aware of any demonstration showing TN control is similarly effective or routinely necessary to preclude

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[41] *See* Chapra Analysis at 4.
[42] *See* Minn. R. 7050.0222.
[43] Statement of Need and Reasonableness, Eutrophication Standards for Streams, Rivers, Lake Pepin, and Navigational Pools, Book 2, Minnesota Pollution Control Agency, 103, *available at* https://www.pca.state.mn.us/sites/default/files/sonar-book2.pdf.
[44] Dove, Alice and Steven C. Chapra. 2015. Long-term trends of nutrients and trophic response variable for the Great Lakes. Limnol. Oceanogr. 60, 2015: 696 – 721.

excessive algal growth." (Chapra Analysis at 5). Please note that Dove and Chapra 2015 presents data from the Great Lakes showing algal levels have decrease in response to TP control while the TN:TP ratio has increased to levels significantly higher than that recommended in the IRRB Report.

Another report by Schindler [45] reviews the evidence for and against the need for both nitrogen and phosphorus control in lakes to reverse cultural eutrophication. This report cites to the success of "phosphorus-only" control in numerous lakes and identifies three types of errors in scientific recommendations that call for dual control of nitrogen. These errors include (i) the assumption that short experiments where nutrients are added to small bottles or mesocosm cannot be extrapolated to whole ecosystems over long time periods, (ii) conclusions about reversing eutrophication by adding nutrient to water rather than decreasing nutrients, and (iii) flawed assumptions and logic about ecosystem-scale nutrient cycling. Before nitrogen control is recommended by the IJC, the Commission needs to review the basis for this recommendation in light of these specific concerns with the literature supporting the need for nitrogen control.

- Technical Supporting Document Does Not Show TN Control Necessary

The paleolimnology study used as the basis for establishing the TP target in Lake Winnipeg (Bunting et al. 2016) made explicit recommendations concerning the need to reduce TP.

> By assuming Lake Winnipeg has been regulated mainly by the influx of P prior to regime shift ca. 1990, we propose that modern TP content in the south basin (~100 μg P L^{-1}) must be reduced ~five-fold to return the basin to mesotrophic conditions characteristic of the preagricultural era (~15-20 μg P L^{-1}). These targets are consistent with the P optimum of the predominant (60-80% of valves) diatom taxon, *Aulacoseira islandica* (~15.4 μg P L^{-1}), determined using a survey of >100 regional lakes, although we caution that factors other than nutrient influx (e.g., physical mixing, Si, light, etc.) appear to be regulating diatom species composition in the south basin (Fig. 6). Similarly, we recommend that modern TP concentrations be reduced to ~50 μg P L^{-1} (50% decrease) to suppress current outbreaks of diazotrophic cyanobacteria and reduce the present surplus of water column SRP (~50% of TP), yet allow for the high interannual variability in river discharge which regulates nutrient influx to the lake. (at 36-37) (Emphasis added)
>
> Finally, we caution that failure to immediately reduce P influx may initiate a final transition in lake state from buoyant N_2-fixing *Aphanizomenon* and *Anabaena* to potentially toxic, but low-light adapted cyanobacteria (*Planktothrix*, *Microcystis*, *Cylindrospermopsis*) due to continued pollution with N, as has occurred in the Canadian Prairies (Patoine et al. 2006; Leavitt et al. 2007), Europe (Scheffer et al. 1990; Bunting et al. 2007), China (Paerl and Scott 2010; Xu et al. 2010), and elsewhere. (at 37) (Emphasis added)

[45] Schindler, D. 2012. The dilemma of controlling cultural eutrophication of lakes. Proc. R. Soc. B (2012) 279, 4322-4333.

Similar recommendations were not made for nitrogen because the determination of water quality targets for nitrogen were outside the scope of the paleolimnoligical studies [46]. While this study noted highly significant correlations between total algal biomass and nitrogen influx for turbid polymictic lakes with > 50 µg P/L as bioavailable SRP and there may be substantial benefits to reducing both nitrogen and phosphorus, we note that the selected TP target will reduce the SRP well below the threshold upon which the nitrogen reduction recommendation was based.

The total nitrogen objective of 0.75 mg/L was derived to preserve a 15:1 nitrogen to phosphorus ratio. (Environment and Climate Change Canada. 2018). The need to preserve this ratio is contradicted by the specific data collected by Dove and Chapra (2015) for the Great Lakes and the review by Schindler (2012). Moreover, if the conditions prevalent in the 1990s serve as the basis for nutrient regulation in Lake Winnipeg, as recommended in the IRRB Report, the N:P ratio at that time should also be preserved if shown to be necessary. The Modeling Report noted that from 1992 to 1994, annual mean N:P for the south basin and north basin ranged from 22:1 to 35:1 and 34:1 to 55:1 respectively. (Modeling Report at 17) These N:P ratios are significantly higher than the proposed ratio.

Summary

As discussed above, TP concentration objectives for Lake Winnipeg were developed to reflect conditions previously seen in the Lake and the proposed load targets were developed consistent with the TP concentration objective for Lake Winnipeg as identified by the paleolimnological studies. This approach seems reasonable. The corresponding concentration and load limits for TN were developed without consideration for actual need and are contrary to Minnesota's approach to addressing eutrophication in lakes and the IJC's approach to addressing eutrophication in the Great Lakes. Moreover, TN control is contrary to specific comments by a recognized expert (Steven Chapra) and is not supported by the underlying science used to support the TP concentration target. Without a specific assessment showing that TN control, in addition to TP control, is necessary to achieve the targets identified for Lake Winnipeg, this IRRB proposal to include a TN concentration objective or load target should be withdrawn.

3. Additional Considerations

The phosphorus load target for the Red River developed to protect Lake Winnipeg suggests that significant load reductions will be necessary to achieve the target concentration in the lake. This will require reductions from both point and non-point sources. We have not seen information showing the relative contributions from these sources, but it would appear from the loading charts presented in the IRRB Report (Figure 7), that point sources represent a small percentage of the overall load. Presuming that this is true, it is not reasonable to impose restrictive concentration or loading limits on these facilities because the cost of treatment is not reasonable for the small overall reduction in load that would be achieved. A primary focus of the Lake Winnipeg restoration project should be a focus on non-point sources. The IRRB should advocate

[46] Manitoba Conservation and Water Stewardship. September 2015. Application of a Water Quality Model to Develop Nutrient Targets for Lake Winnipeg Tributaries at 16. (hereafter, "Modeling Study").

an adaptive management strategy whereby point source dischargers can work with non-point sources to make cost-effective TP load reductions in the system.

Senate
State of Minnesota

Minnesota
House of
Representatives

February 28, 2020

VIA EMAIL ONLY

International Joint Commission
U.S. Section
1717 H Street Northwest, Suite 835
Washington, DC 20006
bevacquaf@washington.ijc.org

RE: Comments on the International Red River Board's recommended nutrient concentration objectives and load targets for the Red River of the North

Dear Commissioners:

We are writing to provide comments on the International Red River Board's ("IRRB") recommendation to the International Joint Commission ("IJC") to add total phosphorus and total nitrogen water quality concentration objectives and load targets for the Red River of the North.

As elected officials who represent communities throughout the Red River Basin, we are interested in this matter because any new IJC water quality objectives could be enforced in the State of Minnesota and have significant economic impacts on the residents and business in the communities we represent. We are especially concerned about the potential impacts for municipal wastewater treatment plants, municipal stormwater systems and the agricultural economy.

Based on recent discussions with several cities in our respective districts, as well as with representatives from the Minnesota Pollution Control Agency ("MPCA"), we agree that it is reasonable to develop a phosphorus load target for the Red River that is necessary to protect Lake Winnipeg and we support the IJC's efforts to do so. It is also our understanding that several cities and agricultural interests in our respective districts are working with the Red River Basin Commission to develop a water quality plan to make progress in this effort and we support that work as well.

However, based on the information provided to us from the Red River Basin cities and MPCA, we have the following concerns with the IRRB's proposed total phosphorus and total nitrogen concentration objectives and the total nitrogen load target for the Red River:

1. The IRRB's recommended concentration objective and load target for total nitrogen is inconsistent with and more restrictive than Minnesota's adopted and EPA-approved River

Eutrophication Standards ("RES") applicable to the Red River. The critical difference is that the RES does not currently regulate for total nitrogen in the Red River.[1]

2. The IRRB's proposed phosphorus concentration objective for the Red River is not tied to a eutrophication response variable, such as algal growth, which is inconsistent with Minnesota's regulation of phosphorus in rivers, including the Red River.[2]

3. Several Minnesota cities that discharge into the Red River have identified key technical deficiencies with the proposed total phosphorus and total nitrogen concentration objectives and the total nitrogen load target.

We are also concerned that the IRRB failed to engage local government stakeholders early in the water quality objective development process. It is our understanding that the IRRB's effort to develop the proposed water quality objectives was primarily driven by representatives of state and federal agencies from the U.S. and Canada and there was no explicit representation from municipal wastewater treatment plants. We appreciate the IJC's efforts to hold the public hearing requested by the cities and the IRRB's efforts to allow their input; however, cities should have been formally included in the IRRB's process from the get-go. We request that you include them directly in such efforts going forward.

As a result of these concerns, we request that you focus your immediate efforts on approving a total phosphorus load target for the Red River that is necessary to protect Lake Winnipeg. In the meantime, we request that you hold off on approving the proposed total phosphorus and total nitrogen concentration objectives and the total nitrogen load target for the Red River and work with Minnesota cities in the Red River Basin to address their technical concerns before moving those proposals forward.

Sincerely,

Senator Kent Eken
Minnesota Senate District 4

Representative Jeff Backer
Minnesota House District 12A

Senator Mark Johnson
Minnesota Senate District 1

Representative Dan Fabian
Minnesota House District 1A

[1] Minnesota's River Eutrophication Standards do not regulate TN in Minnesota Rivers, including the Red River. Minn. R. 7050.0222..

[2] Minnesota's approved RES requires exceedance of algal criteria and total phosphorus criteria before determining an impairment exists. Minn. R. 7050.0150, Subp. 5b.

Senator Torrey Westrom
Minnesota Senate District 12

Representative Debra Kiel
Minnesota House District 1B

Representative Ben Lien
Minnesota House District 4A

Representative Paul Marquart
Minnesota House District 4B

TUFTS UNIVERSITY
School of Engineering

Professor and Louis Berger Chair in Civil & Environmental Engineering

December 6, 2019

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Commissioner Sission
Commissioner Yohe
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United States

Chair Béland
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RE: Scientific opinion on proposed numeric nutrient targets for the Red River proposed by the International Red River Board, IJC Reference 81R

Dear Chairs Corwin, Béland and Commissioners:

I was contacted by the Minnesota cities of Breckenridge, Moorhead, Roseau, and Warroad (the cities) to provide technical input on proposed numeric nutrient criteria for the Red River of the North that are under consideration by the International Joint Commission (IJC). It is my understanding that the IJC is considering proposed stream criteria of 0.15 mgP/L for total phosphorus (TP) and 1.15 mgN/L for total nitrogen (TN) to protect aquatic life uses in the river. Because I have previously worked with the IJC on nutrient control requirements to protect the Great Lakes and have extensive experience on evaluating eutrophication in rivers and streams associated with periphyton and/or algal growth, the cities requested that I provide an opinion on the scientific validity of the numeric nutrient criteria under consideration.

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Fax: 617 627-3994
Email: steven.chapra@tufts.edu

Qualifications

As the IJC is aware, my career has been devoted to the development of technical procedures to evaluate fate and transport of pollutants, with an extensive focus on nutrient dynamics and impact assessment. In this regard, I hold the Louis Berger Chair for Computing and Engineering in the Civil and Environmental Engineering Department at Tufts University. I have published over 200 papers, reports and software packages, and authored seven textbooks concerning the evaluation of water quality in lotic and lentic systems over a career spanning 50 years. My research has been used in several decision-making contexts including transboundary systems. For example, (a) the 1978 Great Lakes Water Quality Agreement and subsequent revisions, and (b) the Abrud, Aries and Mures River system involving Romania and Hungary (Chapra & Whitehead 2009). I was presented the Department of Commerce Special Achievement Award in 1978 for research and publications on Great Lakes eutrophication, and the 2009 Chandler-Misener Award for an outstanding article in the Journal of Great Lakes Research. Most recently, I was presented the Wesley W. Horner Award for the "Parsimonious Model for Assessing Nutrient Impacts on Periphyton-Dominated Streams" (ASCE, 2014).

Questions Considered

I was asked to consider the following questions regarding the technical information that lead to the development of the numeric stream nutrient criteria under consideration by the IJC:

1. Did the RESPEC Report use scientifically accepted methods to derive numeric nutrient criteria for TN and TP?
2. Are the concerns raised by Hall & Associates on behalf of the cities scientifically valid?
3. Does the Consensus Report address and resolve any valid concerns identified by the cities and its consultant Hall & Associates with the RESPEC report?
4. Are the nutrient criteria under consideration scientifically defensible?

Materials Reviewed

I was provided with the following documents for review:

- RESPEC. June 2016. The Development of a Stressor-Response Model for the Red River of the North. Topical Report RSI-2611. Prepared for International Red River Board, US Section.
- Hall & Associates. July 11, 2018. Review of: The Development of a Stressor-Response Model for the Red River of the North. RESPEC. June 2016.
- Walter Dodds & Helen Baulch. Consensus report for the International Joint Commission on RESPEC 2016 report "The development of a stressor-response model for the Red River of the North".

The June 2016 RESPEC Report (The Development of a Stressor-Response Model for the Red River of the North) provides the information used to derive the proposed criteria for TP and TN. The Hall & Associates Report (June 4, 2018) provides a critique of the evaluations and conclusions presented in the RESPEC Report. The Consensus Report is characterized as a peer review of the RESPEC report, with a specific focus on addressing the comments prepared by Hall & Associates. My review considered all the above information but is also intended to

provide an independent assessment of whether the suggested numeric criteria for the Red River of the North are scientifically defensible.

Evaluation

- **General Observations concerning the Reviewed Materials**

Over the course of my 50-year career I have reviewed many analyses that were intended to document "stressor-response" relationships due to nutrient impacts on aquatic life uses. I co-authored the USEPA guidance document for lake nutrient TMDLs (Gibson et al 2000) and have worked with US States to develop stream nutrient criteria (e.g., Flynn et al. 2015; Suplee et al. 2015). I am also very familiar with the USEPA guidance documents specifically developed to ensure scientifically defensible stressor-response nutrient criteria for streams.[1] The title of the RESPEC Report led me to believe that the document would include information and analysis sufficient to support scientifically valid stressor-response based nutrient criteria. Such information would typically include development of a quantitative relationship to predict the response of phytoplankton and periphyton to nutrient inputs to the Red River of the North, accounting for the multiple confounding factors that influence such growth and the effect of "excessive" plant growth on system water quality.[2] This type of approach is the most relevant for developing a site-specific water quality standard and requires the establishment of a nutrient-sensitive endpoint that represents a threshold above which an aquatic life use impairment is likely to occur. Once a threshold is established, the relationship between the nutrient and the response variable may be evaluated, using the site-specific calibrated model that accounts for confounding factors, to determine the numeric nutrient criterion necessary to ensure that the impairment endpoint is not exceeded.

The RESPEC Report presents numerous response metrics based on site-specific data from a floating periphytometer study and from surface samples of phytoplankton collected along the length of the river at a single point in time. Within the Report, taxonomic changes in periphyton and phytoplankton species were used as the major indicator of stressor response and adverse ecological effect. Detailed statistical evaluations are presented in the report to relate the influence of nutrient concentrations on the various response metrics, but no evaluation is presented to identify a threshold for aquatic life use impairment associated with any plant growth metric. Moreover, the RESPEC report did not contain documentation demonstrating that the changing metrics selected provide confirmation of significant ecological impairment.

Without a well-documented and defined impairment threshold, the proposed TP and TN endpoints were merely derived as the average concentration from observations at three stations having the strongest "negative" correlation with elevated nutrient concentrations (RESPEC at 64). The report identifies these sites as having the lowest periphyton biomass, the most desirable phytoplankton communities, and the lowest primary production in comparison with another group of sites. The report then states that the recommended endpoints should be considered nutrient targets to prevent nuisance algal growth in the Red River.

In my opinion, this is not a scientifically defensible method for deriving numeric nutrient criteria to protect aquatic life uses. Plant growth occurs in all healthy ecosystems and its variations are profound. In fact, without plant growth, higher-order organisms would have little capability of

[1] USEPA. 2010. Using Stressor-Response Relationships to Derive Numeric Nutrient Criteria. EPA-820-S-10-001

[2] See the discussion in USEPA (2010) at 37 (Deriving candidate criteria) and at 65 (Evaluate model accuracy).

surviving. While the analyses presented in the report show that lower productivity, less biomass, and potentially "less desirable" communities of periphyton and phytoplankton are associated with lower concentrations of TP and TN, no attempt was made to demonstrate how any of the measured plant growth metrics (artificially induced with floating periphytometers or from actual in-stream data) were indicative of significant system ecological impairment (commonly known as eutrophication). Thus, while productivity may be higher and communities "less desirable", it is not apparent that monitored conditions exceed a threshold that would be considered impaired (i.e., is ecologically significant and hence to be avoided). For example, you might consider an ambient dissolved oxygen concentration of 8.0 mg/L to be more desirable than an ambient DO of 6.0 mg/L, but that does not justify setting a DO criterion of 8.0 mg/L to protect aquatic life. Consequently, the proposed endpoints are not justified because they are not grounded in any demonstrable significant adverse impact from eutrophication or, for that matter, even the existence of a eutrophic condition.

It is noteworthy that most assessments of eutrophic use impairment are based on algal growth as assessed using chlorophyll-*a* concentration and the Minnesota Pollution Control Agency (MPCA) uses a growing season average periphyton chlorophyll-*a* concentration of 150 mg/m^2 and a phytoplankton chlorophyll-*a* concentration of 40 µg/L (southern rivers growing season average) as thresholds for use impairment in streams. The data presented in the report show very low levels of periphyton growth throughout most of the river (See, Table 2-3 and Figure 7-3) using data from *floating* periphytometers to ensure maximum growth. These data, of course, would significantly overestimate the actual attached plant growth occurring in the system, as suspended solids limit light penetration in the Red River of the North. Even so, these data suggest that nuisance algal growth is not occurring in this river, even under artificially ideal growing conditions. Similarly, phytoplankton samples were collected when the river flow was low and conditions for maximizing chlorophyll-*a* concentration were highest. Even under these conditions, the chlorophyll-*a* concentration was low in comparison with the MPCA standard, which is a growing season average and not an instantaneous maximum, or a "low-flow only" criterion. Together, these data indicate that the river is not impaired due to excessive algal growth under the current water quality and nutrient levels in the system.

- **Recommendation for TN Control Is Not Scientifically Defensible**

The RESPEC Report includes a recommendation for a total nitrogen endpoint of 1.15 mg/L to address a presumed eutrophication-based use impairment in the Red River of the North. My research has focused on the evaluation and control of eutrophication through the application of environmental models to predict the fate and transport of nitrogen and phosphorus in lotic and lentic systems. By and large, lentic systems (lakes) are more sensitive to eutrophication than lotic systems (rivers). My work in the Great Lakes system has demonstrated that phosphorus control is generally the only control necessary to limit excessive algal growth in these systems. Through this research, a phosphorus control strategy for the Great Lakes has been quite successful in reducing algal growth in these lakes. Based on this understanding, I was surprised to see the TN endpoint recommendation in the RESPEC Report.

Typically, algal growth control in fresh waters is accomplished by limiting the amount of phosphorus entering the system. Controlling nitrogen can also have negative ecological effects as it provides a competitive advantage for nitrogen fixing blue-green algal forms that can severely impair a freshwater system. The State of Minnesota has premised all its adopted nutrient criteria for lakes and streams on this understanding. Consequently, a justification for nitrogen

control in fresh waters requires demonstrating that phosphorus control is either incapable of controlling algal growth, or that nitrogen control alone, or in combination with phosphorus control, is necessary to reduce algal growth. The RESPEC Report does not contain any such demonstration and, therefore cannot serve as a scientifically defensible basis for the recommended TN endpoint. The Consensus Report cited "literature" supporting the need for TN control. However, as I have noted above, there is no consensus that TN control is necessary in fresh waters, and, if anything, the consensus is that it is not generally a good idea (Schindler et al. 2015). Moreover, while TP control has been shown to effectively limit algal growth in freshwater systems, I am not aware of any demonstration showing TN control is similarly effective or routinely necessary to preclude excessive algal growth.

The authors of the Consensus Report have suggested that a simple correlation analysis, as presented in Figure 2 of their analysis, is sufficient to make this demonstration. That is simply not correct and is not consistent with extensive literature to the contrary. Moreover, the relationship did not consider the correlation between TN and TP in the data. Consequently, the figure cannot be used to justify the need for TN control, absent a more robust and thorough analysis explaining why phosphorus control would be incapable of achieving the intended goal.

- **Necessary Goal of RESPEC Report Not Achieved**

As noted in my general comments, the stressor-response approach for numeric nutrient criteria development requires the identification of a nutrient-sensitive endpoint (e.g., excessive phytoplankton growth that would cause low DO at night) that represents a threshold above which an aquatic life use impairment is likely to occur. In fact, the Consensus Report noted that the Scope of Work under which the RESPEC Report was prepared included a requirement to identify such biological thresholds along a stressor (nutrient) gradient. The Consensus Report determined that specific biological thresholds were not identified by RESPEC. Without the identification of a specific biological threshold and an appropriate stressor-response relationship, scientifically defensible nutrient criteria cannot be developed. The RESPEC Report contains neither of these necessary components. Consequently, there is no confidence that the recommended endpoints are necessary to protect the aquatic life uses of the Red River of the North.

- **Periphytometer Data Should Not be used as the Basis for Nutrient Endpoints**

The RESPEC Report details how conditions in the Red River of the North presently limit the response of periphyton (and phytoplankton growth) to nutrient concentrations in the receiving water. Specifically, elevated suspended solids levels limit light penetration. Consequently, floating periphytometers (approximately one inch below the water surface) were used to evaluate the degree of periphytic growth that could occur if light penetration was not limiting. While this condition maximizes periphytic growth, it is not representative of actual conditions in the river or a rational basis for projecting future periphyton growth under "improved" suspended solids conditions.

Periphyton grow primarily on the river bottom, and even under an improved light regime in the Red River of the North, such growth would not reflect the growth found one inch from the surface. To use such information to set a scientifically defensible nutrient criteria, one would have to know the degree of light penetration occurring under the assumed future lower TSS level (see, Consensus Report at 5 which assumes a 100 mg/L TSS level or less will exist in the future). The RESPEC and Consensus Report nowhere address this critical factor (light penetration) that

controls plant growth in the River. Thus, while the use of floating periphytometers may be useful in identifying the forms of periphytic algae that are present in the river and possible maximum growth levels when growing conditions are optimized, these data are not representative of the relative biomass of these species occurring under existing conditions or reasonably expected to occur in the future. Failure to account for the effects of TSS on the light regime of the river was a fundamental deficiency of both reports.

Response to Specific Questions Posed

1. **Did the RESPEC Report use scientifically accepted methods to derive numeric nutrient criteria for TN and TP?**

No. As discussed above, the numeric nutrient criteria proposed in the RESPEC Report were not based on scientifically accepted methods and had several critical deficiencies. Nutrient criteria are developed to protect designated uses from excessive plant growth and the report failed to identify a threshold metric necessary to protect aquatic life uses or demonstrate the level of plant growth that would be excessive. Without these thresholds, numeric nutrient criteria cannot be scientifically determined. Furthermore, there was no attempt to determine whether TP and/or TN control was necessary to attain the desirable communities of periphyton and phytoplankton assessed in the report. The report merely assumed that the average concentration of TP and TN at the headwater stations was necessary to support lower biomass and more desirable communities. The report presents no scientifically defensible basis for this assumption, which is contrary to Liebig's Law of the Minimum[3], a law of nature underpinning nutrient control strategies throughout the United States and the Great Lakes.

2. **Are the concerns raised by Hall & Associates scientifically valid?**

The Hall Report identified several areas of concern. On review, these concerns focus on three primary areas: lack of an impairment threshold, use of periphytometer data to represent conditions in the river, and the need for TN control to achieve use attainment. In general, these were valid critiques that identified fundamental deficiencies with the RESPEC Report.

In particular, regarding TN control, I concur that far more detailed evaluations are needed to demonstrate the need for TN control. Moreover, the RESPEC Report indicates that the explained algal variance attributed to nutrients was relatively small (15% for periphyton, 16% for phytoplankton) for the specific metrics considered. The explained variance is very low and suggests that the confidence interval around the analysis is very large. If these confidence intervals were reported, it would likely show a range in criteria that make the results of very limited use. I agree with this assessment.

3. **Did the Consensus Report resolve the primary technical issues identified in the Hall Report?**

The Consensus Report characterizes itself as a peer review of the RESPEC Report. As part of this review, the Consensus Report considered five questions. The first question addressed review of the comments in the Hall Report. Overall, the Consensus Report concluded that the concerns identified by the Hall Report were not sufficient to invalidate the RESPEC Report and supported

[3] Simply put, Liebig's Law of the Minimum states that growth is dictated not by total resources available, but by the scarcest resource (the limiting factor).

the proposed TN and TP criteria. I disagree with this finding of the Consensus Report for the reasons discussed above, and those discussed in greater detail below.

The authors attempted to support their conclusion by presenting plots of periphyton chlorophyll-*a* versus nutrient concentration for sites with TSS concentrations below 100 mg/L. They claimed a strong relationship between nutrient concentration and periphyton chlorophyll-*a*, and recommend that the simple relationships (Figure 1, Figure 2) should be included in the RESPEC Report to support the conclusions given the low explanatory power of the multivariate analyses. (Consensus Report at 5). Those relationships are presented below.

Figure 1: Periphyton Chl-a vs TP

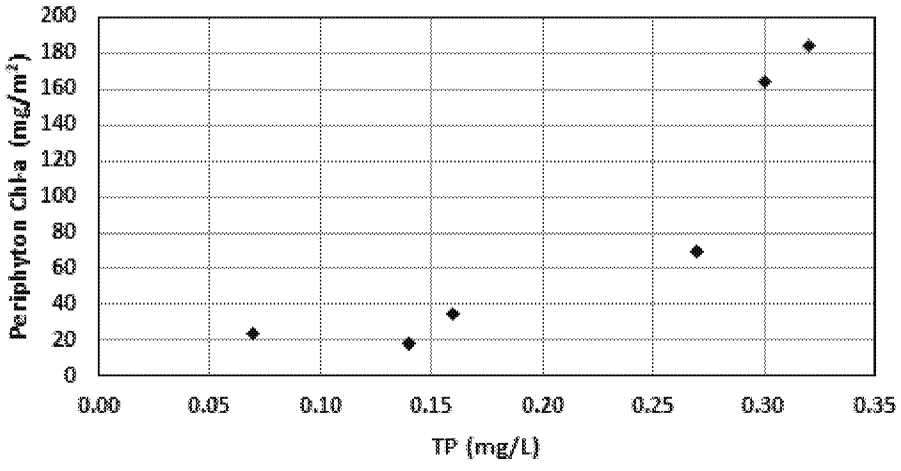
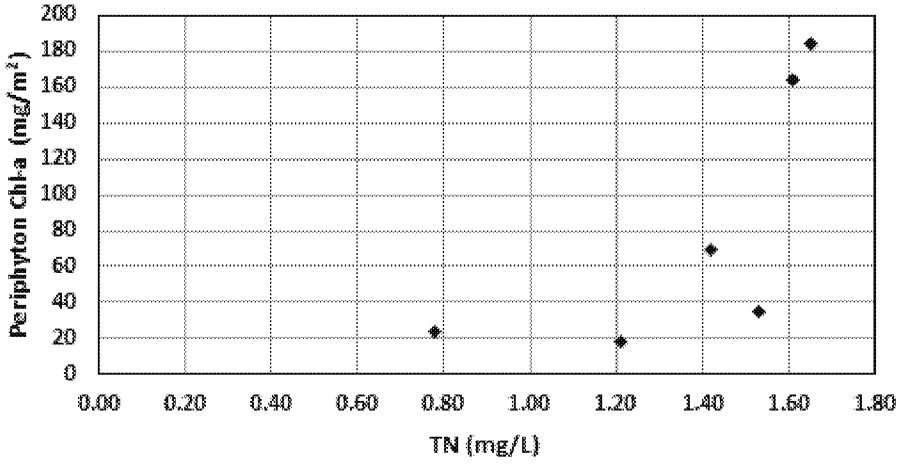


Figure 2: Periphyton Chl-a vs TN

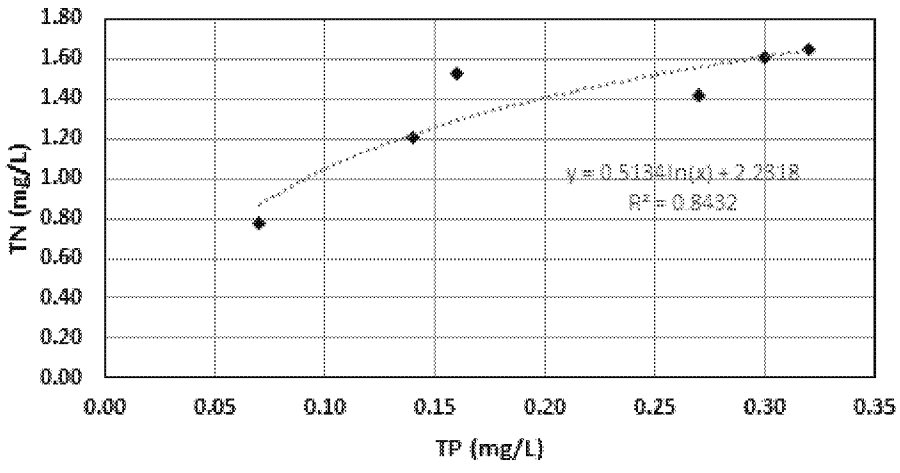


The suggestion that these relationships support the proposed criteria is not scientifically defensible. The simple relationships present maximum periphyton growth on surface mounted slides as if it represents conditions expected to occur in the river. It does not. Moreover, the

maximum periphyton levels at the proposed nutrient criteria concentrations are less than 40 mg chlorophyll-*a*/m^2. This is an exceedingly low level of periphyton biomass and is not recognized as a threshold of impairment by anyone that I am aware of. For example, the State of Montana (Suplee et al. 2009) used public perception surveys to determine that mean bottom algae levels < 150 mg chlorophyll-*a* /m^2 were found to be desirable. These results were consistent with earlier work in the literature suggesting that 100-150 chlorophyll-*a* /m^2 represents a benthic algae nuisance threshold (Horner et al. 1983, Welch et al. 1988, etc.) as well as the Minnesota Pollution Control Agency (MPCA) growing season average periphyton chlorophyll-*a* concentration of 150 mg/m^2.

Moreover, these data are presented as "cause and effect" relationships. However, as I illustrate below in Figure 3, the TP and TN concentrations from Figure 1 and Figure 2 are themselves correlated! Consequently, these data are also insufficient to determine whether TN should be regulated. Finally, I would note that all the periphyton measurements are associated with nutrient levels that far exceed growth limiting concentrations (typically in the 10-20 µg/L range). Thus, it is not apparent why periphyton growth more than "doubled" from 0.27 mg/L TP to 0.32 mg/L TP. It is possible that this was simply a function of measurement variability. In any event, without a more detailed assessment, it is not possible to attribute this apparent change in plant growth to TP concentrations as all conditions had sufficient TP present to allow maximum growth to occur. The fact that periphyton growth was over five times greater at some stations indicates that other unidentified confounding factors are influencing growth.

Figure 3: TP vs TN



The remaining four questions addressed in the Consensus Report focused on the development and application of the stressor-response model in the RESPEC Report. The Consensus Report identified specific charges in the original scope of work and noted that a key goal of the RESPEC Report was "to develop a stressor-response model for the Red River and to use the model to identify biological thresholds/criteria which quantify the thresholds at which biologic response variables in the Red River respond to nutrients". With respect to this goal, the Consensus Report noted, "They did not identify specific biological "thresholds" (point 6), rather they found conditions in least impacted areas and used those to recommend criteria." Thus, the Consensus Report in fact agreed with the Hall Report regarding a major deficiency that precluded the development of valid stressor-response based nutrient criteria.

This is the crux of the matter. Notwithstanding the other serious deficiencies of the analysis, without a threshold to evaluate use attainment, a scientifically defensible nutrient target cannot be identified.

4. Are the nutrient criteria under consideration scientifically defensible?

No. The evaluations presented in the RESPEC Report evaluated numerous biological metrics but did not show how any of these metrics affect aquatic life uses or at what threshold value aquatic life uses would be impaired. Consequently, there is no way of evaluating whether the proposed numeric criteria are appropriate. In addition, the Report did not present a stressor-response relationship along a nutrient concentration gradient, contrary to the explicit scope of work requirement. Instead, the criteria were determined as the average concentration from three sites with an artificially maximized periphyton chlorophyll-*a* concentration of 19.5 mg/m^2. I cannot imagine any circumstance where this level of periphyton growth would represent a threshold for aquatic life impairment. If the effect of confounding factors such as TSS are properly considered, the actual amount of periphyton growth in the river would be much lower and the necessary numeric nutrient criteria will be much higher than the proposed limits.

Conclusion

I hope that you find my observations helpful in determining the best path forward for protecting aquatic life uses in the Red River of the North in a cost-effective and sustainable fashion. At this point, I do not see any defensible basis presented for asserting that a TP criterion of 0.15 mg/L and a TN criterion of 1.15 mg/L are required to protect or restore uses in the river.

Sincerely,

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IISD Experimental Lakes Area

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31 March 2020

International Joint Commission
Red River Basin Committee

Re: Proposed nutrient concentration objectives and loading targets for the Red River at the US/Canada boundary

The IISD Experimental Lakes Area (ELA) represents one of the few locations in the world where whole ecosystem experiments can be undertaken to assess human impacts on the environment. In fact, the ELA was established by the Federal Government of Canada in 1968 for the express purpose of providing policy makers and advisors, such as the IJC, strong scientific guidance in relation to the policy and management of eutrophication. At the time, the science surrounding the eutrophication issue was controversial and in disagreement. It was determined that given the significant economic costs associated with this problem, that whole ecosystem experiments should be undertaken to assess the roles of carbon, nitrogen and phosphorus in causing algal blooms in the Laurentian Great Lakes and in freshwaters around the world.

The reason why whole ecosystem experiments were needed was because small scale bottle assays and comparative monitoring of nutrient status indicators often provided contradictory results and included a large number of unstated assumptions (e.g. scaling from small bottle experiments to whole ecosystems, scaling from short term experiments (weeks) to realistic timeframes (decades), and inclusion of important processes such as nutrient recycling and air water gas exchange) that needed to be tested at appropriate spatial and temporal scales. We note that the IJC currently appears to be basing its decision also on these small-scale experiments and surveys without consideration of large-scale experiments that were designed for the very purpose of guiding policy on this issue. The eutrophication experiments at the ELA were highly influential in guiding the IJC and policy makers to address the eutrophication problems in Lake Erie and in lakes around Canada and the United States. The prime recommendation of the ELA research was that policy makers and managers should focus on reducing phosphorus loads to lakes, and that reductions in carbon and nitrogen would be ineffective. **We cannot fathom why the results of the whole ecosystem experiments at the ELA, which are directly pertinent to the consideration of nutrient loading targets for the Red River and Lake Winnipeg, which have been widely published and important for public policy in Canada and the United States on this issue, have not been referenced in the background materials of this proposal or considered in the establishment of nutrient targets**.

The ELA has continued to research the drivers and solutions of eutrophication, undertaking the longest controlled whole ecosystem experiment (Lake 227 experiment) on eutrophication in the world (>50 years, 1969-present). In this experiment, nitrogen and phosphorus were loaded to the lake for 5 years at a ratio (27N:1P) that would support 'balanced growth' by algae (in other words, nitrogen and

phosphorus were added in proportion to what algal cells require) and examine the potential for carbon limitation. This nutrient loading regime produced large algal blooms within the first year, demonstrating that carbon was not the ultimate cause of algal blooms. For the next 14 years, the amount of nitrogen added was reduced to levels below algal requirements (9N:1P), to assess the implications of nitrogen loading reductions. There were no reductions in the magnitude of algal blooms. Rather, algal species capable of fixing atmospheric nitrogen (N_2 gas) that could be constantly replenished by diffusion into the lake from the atmosphere, dominated. Subsequently, it was argued [1] that lake nitrogen concentrations remained high due to the prior loadings and that once these 'background' concentrations declined the lake would become nitrogen limited. For this reason the experiment was continued for an additional 30 years. In this phase, we continued to add phosphorus but reduced artificial N loads (i.e. only natural loads from the atmosphere and watershed occurred) to zero. Despite the complete elimination of anthropogenic nitrogen loads for an additional 30 years, there was no reduction in the magnitude of algal blooms. The reason, the algal community was able to offset N loading reductions by fixing sufficient atmospheric nitrogen that there was no change in the magnitude of the algal bloom [2, 3]. **The implication for lake Winnipeg is that billions of dollars are being proposed for nitrogen removal for point source load reductions (City of Winnipeg), the IJC is considering even more expensive reductions to address non-point source loads, and there is scant evidence that the reductions in nitrogen loading will have ANY measurable reduction in the magnitude of algal blooms in Lake Winnipeg regardless of the timeframe**.

In 2019, two new whole-lake experiments were initiated at the ELA to assess drivers of eutrophication. In these experiments, two lakes (a shallow non-stratified lake, and a deeper stratified lake) were fertilized with phosphorus only. In terms of nitrogen, only natural atmospheric and watershed loads occurred – no direct anthropogenic loading of nitrogen occurred. We anticipated that it could take 1-2 years for the algal community of the lake to shift towards species that were capable of nitrogen fixation. Thus, we did not expect to find algal blooms in the first few years. We were surprised that within the first year, large algal blooms occurred. In other words, anthropogenic phosphorus additions, without ANY anthropogenic nitrogen addition, was capable of producing large algal blooms. **These two additional experiments support the results of the L227 experiment and indicate that reductions in nitrogen loading would not significantly reduce the magnitude of algal blooms in Lake Winnipeg**. Rather, these experiments indicate that **the primary focus of eutrophication control should be on significantly reducing phosphorus loads from both point and non-point sources**.

Why do small scale experiments and monitoring data suggest N limitation?

As previously noted, in the 1950's through the early 1970's, there was strong disagreement among small scale experiments and monitoring data as to the cause and most effective management solutions for algal blooms, and that for this reason the Government of Canada invested considerable resources to

undertake whole ecosystem experiments to address the policy and management questions surrounding this issue. It is pertinent to note that recently, as during the 1950's through the early 1970's, small scale assays and monitoring data continue to provide highly contradictory results in relation to nutrient status indicators. **As a result, while P abatement is strongly and universally accepted within the scientific community as a mechanism to address eutrophication, N removal remains highly controversial.**

A critical theorem in ecology, as in agriculture, is Liebig's Law of the Minimum. Essentially this 'law' states that the element in least supply controls the growth rate and biomass of plants. Laboratory bottle assays or small-scale enclosure experiments are intended to address which element is limiting algae in lakes. There are many positive aspects of such experiments. Given their small size and relative ease they are highly reproducible. Given their ease, many researchers undertaken them. However, while reproducible are such experiments realistic: Are the results transferable to natural ecosystems? The answer is, unfortunately, no. Eminent freshwater researchers, including Stephen Carpenter and David Schindler (both recipients of the Stockholm Water Prize and numerous other prestigious awards) and many others, have expressed significant doubts over the results of these small-scale experiments. Stephen Carpenter even wrote a scathing scientific manuscript [4] calling into question their utility to address conservation issues like eutrophication that need to be assessed at the ecosystem scale. At the heart of their criticisms are several points: 1) short term experiments do not allow the algal community to shift towards species capable of nitrogen fixation; 2) bottle assays do not allow air-water gas exchange or nutrient exchange with the sediments; and 3) the results the experiments are often misinterpreted. In relation to point #3, it should not be surprising that when phosphorus loading is very high that another element such as nitrogen becomes limiting to growth. Interpreting such a result to mean that nitrogen load reductions would cause measurable reductions in algal biomass in natural systems is highly flawed as demonstrated by the whole ecosystem experiments. As demonstrated by whole ecosystem experiments, reducing nitrogen loads would simply stimulate additional nitrogen fixation with minimal effects on the magnitude of the algal bloom. Rather, ***even where there are indicators of nitrogen limitation the underlying problem is almost always high phosphorus loads***.

What is the state of the science?

There is no debate in the scientific community over the merits of phosphorus load reductions to address the issue of algal blooms. There is strong scientific evidence that P loading reductions have reduced the magnitude of algal blooms in many systems including in Lake Erie. The same cannot be said for N loading reductions. **There is currently a high degree of controversy within the scientific community over the merits of N load reductions [1-3, 5-9]**. While there are certainly supporters of N load reductions, there are also a large number of scientists expressing doubt. The vast majority of support for N load reductions comes from small scale experiments and some monitoring studies that include indicators of N deficiency. These experiments have not been validated at the ecosystem scale. Rather,

the whole ecosystem experiments that have been undertaken have demonstrated that nitrogen fixation is generally capable of offsetting N load reductions. In the case of Lake Winnipeg, there is no evidence that the algal community in Lake Winnipeg would be restricted in their ability to offset N loading reductions through increased rates of nitrogen fixation.

Our recommendation

Given the high uncertainty and very high costs associated with N load reductions to address eutrophication, we call into question the IJC's proposed nitrogen targets to address eutrophication in the Red River and Lake Winnipeg. Rather, to address these serious algal bloom issues we strongly recommend that the available resources be focussed on phosphorus load reductions. Such efforts are much more cost effective, have proven effectiveness in Lake Erie and many other systems [2, 3, 6-11], have been strongly linked to the magnitude of algal blooms in Lake Winnipeg [12] and would be more effective at addressing the algal bloom issues in Lake Winnipeg.

Further, we implore the IJC committee to not exclude the body of literature that calls into question the efficacy of N load reductions and in particular the whole ecosystem experiments [2, 3, 9, 13] that were explicitly designed to test the assumptions and efficacy of N abatement programs.

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